IN THE SPECIFICATION

On page 17, starting at line 6, and ending on page 18, line 12, please amend as follows:

"Spatial Resolution Enhancement

Referring to FIG. 2, the CAMIS sensor head 11 comprising the four Sony XC-8500CE interline transfer, black-and-white progressive scan, CCD video cameras 12-15 with 782 x 576 square pixels each, provides a total of 1.82 million effective pixels. By attaching interchangeable narrow band interference filters 18-21 on the front optics of each of the cameras 12-15, four user-selectable spectral bands 30-36, such as NIR, red, green, and blue, can be captured with non-compromised color separation. These four interline transfer (IT) progressive scan, CCD cameras 12-15 are synchronized and aligned in parallel with sub-pixel ~~accurate~~ spatial ~~offsets~~ offset tolerance over a common field of view. Considering that the area of each sensing element of an interline transfer CCD is partially masked with aluminum coating for buried vertical shift registers and the light sensing area fills only 25% of an imaging pixel (shown in FIG. 3), sub-pixel spatial offset permitted in the alignment is useful for providing spatial resolution enhancement. In other words, these slight sub-pixel variations in camera alignment make the 25% fill area (e.g. axa in FIG. 3) of each camera pixel see a slightly different detail within a ground pixel (e.g. AxA in FIG. 3) . By appropriately aligning the camera mount with all the partly filled 1564 x 1152 sensing elements of four cameras 12-15 and ~~contiguously distributing~~ digitally re-distributing them evenly over a field overview, results in a special sensor head 11 that is equivalent to a large format single chip multispectral CCD with 1564 x 1152 pixels but non-compromised configurable color separation. Together with progressive scan technology, the CAMIS achieves full-frame electronic shutter operation synchronized for all its four cameras 12-15, resulting in a high spatial resolution of 1564 x 1152 sensing dots captured simultaneously."

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On page 19, starting at line 20, and ending on page 21, line 20, please amend as follows:

"Referring to FIG. 4, a perspective view of a non-offset alignment is shown for four bands of images from the four cameras 12-15. ~~The~~ This non-offset CAMIS 10 alignment strategy requires that the four cameras 12-15 are precisely aligned so that all the four bands 71-74 of imaging are superimposed one over one without significant sensing element offset as illustrated in FIG. 4. This alignment method takes the four-band image with the same number of sensing dots as those of one band image. Therefore, the spatial content obtainable by this imaging mode will not increase. In addition, in practice this alignment method is difficult to be implemented exactly as it is designed because of the real-world errors, which include the optical and mechanical parts tolerance permitted in the manufacture process, and the imperfections of the alignment. In the worst case, these misalignment errors can be as big as 0.5A/B steps.

Referring to FIG. 5, a half-pixel offset alignment method is shown for four bands 81-84 of images from the four cameras 12-15. As previously described, the IT CCD imager with square pixel geometry ($A=B$) typically has a fill-factor of 25%. Hence, the sensing area for a pixel is only a quarter of the pixel area. According to this feature of the IT CCD imagers 12-15, a half-pixel ~~(0.5A, 0.5B)~~ (~0.5A, ~0.5B) offset alignment method for CAMIS 10 has been employed to improve the spatial imaging performance as shown in FIG. 5.

The half-pixel alignment method requires that the four cameras 12-15 are aligned so that all the four bands 81-84 of imaging have a half pixel or so ~~(the size of one sensing element)~~ offset to each other (in practice ~0.5, ~1.5, and ~2.5A (or B) offset is allowed) . With the same imaging area of a single CCD imager, this method increases the sensing dots of the four-camera image by a factor of four compared to the single camera image. Therefore, the spatial content of the imaging is quadrupled. In other words, the CAMIS 10 that comprises four spectral bands 81-84 of progressive scan CCD video cameras 12-15 with 782

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x 576 square pixels each gives a total of 1.82 million effective sensing dots using this half-pixel offset camera alignment method.

The CAMIS 10 with four individual 782 x 576 square pixel CCD imagers 12-15 is equivalent to a 1564 x 1152 single chip CCD imager using half-pixel offset alignment concept. Also, the four imagers 12-15 comprise the four interchangeable independent narrow band interference filters 18-21. Therefore, CAMIS 10 provides much better color separation and more flexible band configuration than that of any single chip CCD imager achievable. Furthermore, the present four CCD imagers 12-15 can achieve a much better data bandwidth (60 frames of 1564 x 1152 images per second) than that of a 1564 x 1152 single chip CCD (best achievable at this movement is 12 frames of 1564 x 1152 images per second) for high speed remote sensing using jet aircraft or other high speed low altitude platforms."

On page 22, starting at line 17, and ending on page 23, line 3, please amend as follows:

"Referring now to FIG. 7, a combined graphic/flow chart is shown for high resolution, larger-format imaging using four bands 81-84 of interline transfer CCD cameras 12-15 that are optically aligned with a half pixel (one sensing element) offset to each other and a flow chart for high-resolution image reduction. Original images are received from the four individual IT CCD cameras 12-15 simultaneously. Four bands 91 of images as shown in FIG. 7 are the data sources 92. The digitized images need to be resampled-up for example, from 782 x 576 to 1564 x 1152, (See FIGS. 6c and 6d) to take advantage of the fine, sub-pixels-sized sensing elements or finer pixel pitch that permits finer band shifting for better band-to-band registration."

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On page 24, starting at line 18, and ending on page 26, line 24, please amend as follows:

"The NAI algorithm is compatible with the continuous tone natures of the Earth scene and hence can restore the original scene for Earth remote sensing in general and get the spatial resolution enhanced. After the NAI interpolate 93 operation, a lens geometric correction or calibration step can be added as an optional procedure for each band using a third party subroutine such as is provided in the Matrox Imaging Library Version 6.1. Then, the band-to-band pixel registration 94 which shifts different bands in 0.5A, 0.5B steps to make all bands (originally have offsets of ~0.5A(B), ~1.5 A(B), ~2.5A(B),...) superimposed precisely, of the multispectral data superimposition operation is performed to complete the high-resolution precision image restoration 95. After cropping edges, the output format of the spatial resolution enhanced image is 1520(H) x 1140(V) x 4(Bytes), which amounts to 7.0 Mbytes.

One additional benefit of the resampling-up operation is that the band-to-band pixel registration 94 can be done more accurately, with half pixel stepped *0.5A* or *0.5B* accuracy per dimension referring to the original captures. However, it should be pointed out that the resampling-up operation requires the camera to be well aligned with half-pixel offset without significant errors, so that the fold of the resampling-up is fixed as two in either horizontal or vertical dimensions. In the case of, when smaller camera alignment error needs to be considered, for example, about 0.25A or 0.25B steps in the misalignment, the folds of resampling-up may need to be increased to bigger than two. Therefore, the band-to-band pixel registration 94 can be adjusted at a level even less than a half-pixel in each dimension. This method is referred to as Precision Registration After Resampling-up (PRAR).

Referring to FIG. 9, a flow chart of a high-resolution multispectral image batch processing program 100 is shown using a pixel precision registration after resampling-up (PRAR) algorithm. The batch processing program first initializes 102 for memory allocation, image array parameter definitions, and pixel registration parameters retrieved via Windows

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graphic user interfaces (GUI). Next, it loads the first image file 104 into the memory, and initiates the resampling-up subroutine 106 to resample image-up using NAI algorithm (FIG. 8) for the subroutine. The pixel registration is performed followed by shift bands in the subpixel ~~alignment~~ pitch shifting with increased precision using smaller quantum steps or finer pitch (1/2 original pixel step for two fold resampling-up) within the resampled-up image format (1536 x 1152 x 4 bands). The shifting band operation with the shift distance of 0.5A(B), 1.5A(B),...depending on the original camera mounting condition for band-to-band registration will make the image bigger than 1536 x 1152 and the edge columns and rows with band loses or color missing. Therefore, these edges need to be cropped. After cropping edges 108 the processed, spatial resolution enhanced, larger format images 112 are saved in a computer graphic file format. The program 100 checks if there are any unprocessed 768 x 576 x 4 band image files left in the computer hard disk for processing. If yes, a new file is fetched to process. The program 100 keeps processing image files in the loop until the complete batch job done."

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